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The time period for reply, if any, is set in the attached communication.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte CATHERINE B. LABELLE,
BOON-YONG ANG, JOONG S. JEON,
ALLISON K. HOLBROOK,
QI XIANG, and HUICAI ZHONG

Appeal 2009-006469
Application 10/705,347
Technology Center 1700

Decided:¹ July 22, 2009

Before BRADLEY R. GARRIS, TERRY J. OWENS, and CATHERINE Q.
TIMM, *Administrative Patent Judges*.

GARRIS, *Administrative Patent Judge*.

DECISION ON APPEAL

¹ The two-month time period for filing an appeal or commencing a civil action, as recited in 37 C.F.R. § 1.304, begins to run from the Decided Date shown on this page of the decision. The time period does not run from the Mail Date (paper delivery) or Notification Date (electronic delivery).

Appellants appeal under 35 U.S.C. § 134 from the Examiner's decision rejecting claims 21-34. We have jurisdiction under 35 U.S.C. § 6.

We AFFIRM for the reasons expressed in the Answer and below.

STATEMENT OF THE CASE

Appellants claim a method for forming a field-effect transistor which comprises etching a gate electrode layer and a high-k dielectric layer to form a gate stack, utilizing a nitrogen plasma to nitridate the sidewalls of the gate stack immediately after the etching step, and wherein the etching and nitridating steps are performed in the same plasma process chamber.

The claimed subject matter is adequately represented by independent claim 28, which reads as follows:

28. A method for forming a field-effect transistor including a high-k dielectric layer situated over a substrate and a gate electrode layer situated over said high-k dielectric layer, said method comprising steps of:

etching said gate electrode layer and said high-k dielectric layer to form a gate stack, said gate stack comprising a high-k dielectric segment situated over said substrate and a gate electrode segment situated over said high-k dielectric segment, said gate stack comprising sidewalls;

utilizing a nitrogen plasma to nitridate said sidewalls of said gate stack immediately after said step of etching said gate electrode layer and said high-k dielectric layer;

wherein said step of etching said gate electrode layer and said high-k dielectric layer to form said gate stack is performed in a plasma process chamber being utilized to perform said step of performing said nitridation process on said gate stack;

repairing damage on said sidewalls of said gate stack caused during said step of etching said gate electrode layer and said high-k dielectric layer;

forming source/drain regions adjacent to said gate stack;

fabricating spacers on said sidewalls of said gate stack;

performing a rapid thermal anneal on said gate stack.

The references set forth below are relied upon by the Examiner as evidence of obviousness:

Ballance	US 6,090,210	Jul. 18, 2000
Alers	US 6,265,260 B1	Jul. 24, 2001
Tu	US 6,566,250 B1	May 20, 2003
Aronowitz	US 6,759,337 B1	Jul. 6, 2004
Chang ('240)	US 2004/0188240 A1	Sep. 30, 2004
Change ('964)	US 2005/0019964 A1	Jan. 27, 2005
Colombo	US 2005/0079696 A1	Apr. 14, 2005

The Examiner rejects all appealed claims under 35 U.S.C. § 103(a) as being unpatentable over Colombo in view of Alers or Tu as evidenced by Change '240 or Ballance or Aronowitz or Chang '964.²

The Examiner concludes that it would have been obvious for one with ordinary skill in the art:

(1) to perform Colombo's nitridation step with the nitridation techniques disclosed by Alers and Tu (¶ bridging Ans. 3-4);

(2) to practice Colombo's nitridation step immediately after the etching step (¶ bridging Ans. 4-5); and

(3) to perform Colombo's etching and nitridation steps in the same plasma process chamber in view of Chang '240 or Ballance or Aronowitz or Chang '964 (Ans. 5).

² In related Appeal No. 2007-0287, a Board panel affirmed a § 103 rejection based on the above references of method claims similar to representative method claim 28.

ISSUE

Have Appellants shown error in any of the Examiner's previously noted conclusions of obviousness?

FINDINGS OF FACT

Appellants do not dispute the Examiner's finding that each of Alers and Tu discloses nitridation using a nitrogen plasma (Ans. ¶ bridging 3-4).

Likewise, Appellants do not disagree with the Examiner's finding that Colombo discloses the process steps for the exemplary method depicted in Figure 4 may be practiced in different orders and may not all be required (¶ bridging Ans. 4-5; Colombo ¶ [0026]).

Finally, Appellants also do not contest the Examiner's finding that it is known in the prior art to perform etching and nitridation steps in the same process chamber as evidenced by Chang '240 or Ballance or Aronowitz or Chang '964 (Ans. 5).

PRINCIPLES OF LAW

When considering the obviousness of a claim to the combination of prior art elements, the question to be asked is whether the improvement is more than the predictable use of prior art elements according to their established functions. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007).

A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant. *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994).

ANALYSIS

Appellants' arguments are directed to independent claims 21 and 28 only and these independent claims have been argued together as a group. None of the remaining (dependent) claims on appeal has been separately argued. Therefore, all appealed claims will stand or fall together as a group, and we select independent claim 28 to represent this group. *See* 37 C.F.R. § 41.37(c)(1)(vii)(2007).

In opposition to the Examiner's conclusion that it would have been obvious to perform Colombo's nitridation step immediately after the etching step, Appellants advance the following argument:

[B]y performing the nitridation process immediately after the step of etching the gate electrode layer and the high-k dielectric layer, the opportunity for undesirable lateral diffusion of oxygen into the high-k dielectric material and the transistor gate is advantageous[ly] limited by the invention as specified in independent claims 21 and 28. In contrast, by disclosing that the process steps in the method in Figure 4 may occur in different orders, Colombo teaches away from any specific advantage that may be achieved by performing the nitridation process immediately after the step of etching the gate electrode layer and the high-k dielectric layer.
(Br. ¶¶ bridging 8-9).

This argument is unpersuasive.

Colombo does not teach away from the performing Colombo's nitridation step immediately after the etching step because no disclosure in this reference would have discouraged an artisan from so performing these steps. To the contrary, Colombo's disclosure in paragraph [0026] would have suggested practicing the etching and nitridation steps in the manner proposed by the Examiner. As for Appellants' statement that the claim feature under consideration advantageously limits undesirable oxygen

diffusion, we emphasize that Appellants do not even assert much less show that such an advantage is unexpected and therefore indicium of nonobviousness. In fact, Colombo's teaching that nitridation avoids damaging oxidation (§ [0022]) indicates that the aforementioned advantage would have been expected.

Appellants also argue that it would not have been obvious to practice Colombo's nitridation step using a nitrogen plasma as taught by Alers or Tu because "the subject matter of Colombo . . . is significantly different than the subject matter of Alers and Tu" (Br. 9, first full ¶; *see also* ¶ bridging 9-10). Similarly, Appellants contend that it would not have been obvious to perform Colombo's etching and nitridation steps in the same process chamber in view of Chang '240, Ballance, Aronowitz, or Chang '964 because "the transistor gate disclosed in Colombo is significantly different than the structures disclosed in Chang '240, Balance [sic, Ballance], Aronowitz, and Chang ['964]" (Br. 10, first full ¶; *see also* ¶ bridging 10-11 and first full ¶ on 11).

These arguments reveal no error in the obviousness conclusions under review. The mere fact that the subject matter of Colombo differs from that of the secondary references is inadequate to show error. On the other hand, an obviousness conclusion is supported by the fact that the Examiner's proposed combination of Colombo with the prior art techniques of the secondary references appears to yield no more than the predictable use of these prior art techniques according to their established functions.

CONCLUSIONS OF LAW

Appellants have not shown error in any of the Examiner's previously noted conclusions of obviousness.

For this reason, we sustain the Examiner's § 103 rejection of all appealed claims as being unpatentable over Colombo in view of Alers or Tu as evidenced by Chang '240 or Ballance or Aronowitz or Chang '964.

ORDER

The decision of the Examiner is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(v)(2008).

AFFIRMED

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